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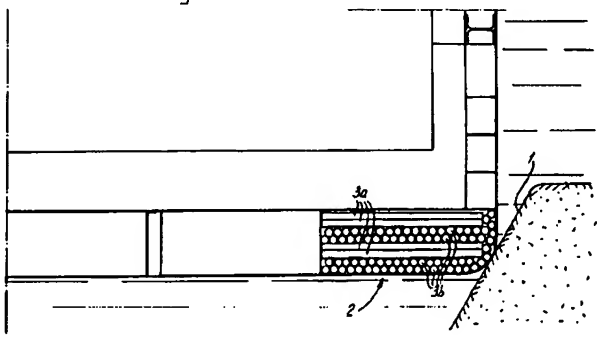
(54) Tube construction with adjoining layers of tubes

(57) A tube construction, intended in particular for hull or shell sections of vessels or wall sections of tanks, consists of a number of layers of adjoining tubes. Some of the tubes extend essentially perpendicularly with respect to the other tubes. In the event of a collision, some of the tubes will be crushed flat and the other tubes will be subjected to buckling. This leads to a situation where the membrane stresses generated in the outer skin are such that the material of the skin displays relatively extensive stretch before tearing could occur. Preferably, the tubes are formed by fixing plate sections to one another or clamping them against one another.

fig-1



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Description

The invention relates to a tube construction with adjoining layers of tubes.

A construction of this type is disclosed in WO-A 92/10396. This known construction forms an outer hull fitted onto the main hull of a vessel. The tubes can be filled with liquid or gas.

A first objective of the invention is so to increase the strength of such a tube construction with adjoining layers of tubes that in the event of a collision or crash the damage will be limited as far as possible and tearing will be prevented.

According to the invention, the tube construction is to this end characterised in that some of the tubes extend essentially perpendicularly with respect to the other tubes.

In the event of a collision, some of the tubes will be crushed flat and the other tubes subjected to buckling. This combination of crushing flat and buckling leads to a situation where the membrane stresses generated in the outer skin of the construction are such that the material of the skin displays relatively extensive stretch before tearing could occur. The collision damage is restricted to a minimum. In many cases, leakage is prevented.

A construction produced according to the invention can be manufactured exceptionally efficiently and inexpensively if the tubes are formed by fixing plate sections to one another or clamping them against one another, some of the plate sections (X direction) being rotated through 90° with respect to the other plate sections (Y direction).

When used for a ship's shell or tank wall, a smooth covering skin can be applied to a plate section on at least one side of the tube construction.

So as to be able to absorb even more energy in the event of a collision, the tubes can be filled, for example with rock wool or foam.

The construction made up of plate sections is also outstandingly suitable for a heat exchanger.

A large number of combinations are possible with regard to the tubes running in the X direction and in the Y direction. For instance, it is possible for pairs of adjoining plate sections with tubes in the X direction to alternate with pairs of adjoining plate sections with tubes in the Y direction.

It is also possible for the construction to consist of, in succession, a tube extending in the X direction, a tube extending in the Y direction, two tubes extending in the X direction, a tube extending in the Y direction and a tube extending in the X direction.

Another advantageous construction for the double-skin hull of a ship is characterised in that said construction consists of, in succession, two tubes extending in the X direction, two tubes extending in the Y direction and two tubes extending in the X direction.

The construction according to the invention is outstandingly suitable for manufacture from a plastic composite. Other materials are metal, wood and bamboo. The advantage of plastic composite is that this material is corrosion-resistant when glued. Steel has the disadvantage that crack corrosion can occur at the location of point welds.

If the open or closed tubes are filled with a lightweight foam or other lightweight material, buoyancy can essentially be maintained under all circumstances. Leaving the tubes open changes the useful volume hardly at all. If use is made of closed tubes, the buoyancy is largely retained should a leak in the outer skin nevertheless occur in the event of a collision.

The invention will now be explained in more detail with reference to the figures.

Figure 1 shows part of the double-skin bottom and double-skin side shell of a vessel during a collision test.

Figure 2 shows a perspective view of part of a particular embodiment of a tube construction according to the invention.

Figure 3 shows a perspective view of a ship's shell consisting of sections.

Figure 4 shows a perspective view of a tube construction which can be compared with the tube construction in Figure 3 but is more extensive and can be used, inter alia, as a heat exchanger.

Figures 5 and 6 show two other possible embodiments of a construction consisting of sections.

In Figure 1 the face of a training wall is indicated by 1. This sloping line can also be considered to be the line along which the force of any collision takes effect.

The double-skin shell of the vessel subjected to the collision is subdivided into chambers by bulkheads. One of these chambers is chamber 2, which comes into contact with the face 1 of the training wall. The chamber 2 is filled with tubes 3a and 3b. The direction of orientation of the tubes 3a is perpendicular to the outer skin of the double-skin side shell of the vessel, whilst the direction of orientation of the tubes 3b is parallel to the outer skin. The tubes 3a are subjected to buckling under the force of a collision and the tubes 3b are crushed flat under the force of a collision. The result of the collision is that a large part of the collision energy is absorbed by the buckling of the tubes 3a and the crushing flat of the tubes 3b and that, as a result, the membrane stresses generated in the outer skin of the chamber 2 are such that the material of the skin displays extensive stretch before tearing would take place. The collision damage is restricted to a minimum. Leakage is less likely to occur.

The tubes can have a cross-section other than a circular cross-section, such as a hexagonal or oval cross-section. In the case of a hexagonal cross-section, the tubes can form a honeycomb structure. This results in substantial reinforcement of the ship's shell or the tank wall.

If the chamber 2, in which the tubes 3a and 3b are arranged, has to provide buoyancy, the tubes will be closed. In the event of a leak in the outer skin, the buoyancy of the tubes in any event remains. If the tubes are filled with lightweight foam, the buoyancy can be main-

tained without the tubes having to be closed. By filling the tubes with mineral wool even more energy can be absorbed in the event of a collision.

If the chamber has to be used as a tank (ballast tank, fuel tank or transport tank), the tubes 3a and 3b will be open.

The tubes can be fixed or stacked separately on top of one another.

Figure 2 shows an embodiment in which the double-skin ship's side shell and ship's bottom is filled with or consists of tubes with a square cross-section which are joined to one another and are optionally filled with foam. The outer skin is indicated by 5. The inner skin consists of wall sections of the tubes 4. The tubes 4 which follow one another in the vertical direction extend perpendicularly to one another.

The embodiment according to Figure 3 differs from those according to Figures 1 and 2 in that the ship's side shell or bottom is essentially made up of trapezium-shaped plate sections 6, 7, 8 and 9 and a flat skin plate 10. The plates 6 and 9 have been rotated through 90° with respect to the plates 7 and 8.

In the embodiment according to Figure 4, the tube construction is even more extensive, a construction being produced which, apart from being resistant to tearing in the event of a collision, can also be used as a heat exchanger. X, Y and Z denote the various directions. Viewed in the Z direction, one or two tubes in the Y direction alternate with one or two tubes in the X direction. Robust, virtually tear-resistant shells or walls can, for example, be designated by the following X-Y codes:
XYXXYX, YXYYXY, YYXXYY and XXYYXX.

A surprising effect of the invention is that as a result of filling a hollow construction, which may be subjected to collisions, with tubes perpendicular to one another, tearing will not easily occur in the event of a collision.

In the event of fire in the vicinity of a shell or wall according to the invention, cooling water could be fed through the shell or wall in the two directions perpendicular to one another.

The shell or wall with tubes in two directions is outstandingly suitable for feeding through cables.

A plastic composite can be an important material for the tubes.

Claims

1. Construction made up of tubes, intended in particular for a ship's shell or bulkhead, a tank wall or partition, or the like, characterised in that some of the tubes extend essentially perpendicularly with respect to the other tubes.

2. Tube construction according to Claim 1, characterised in that the tubes are formed by fixing plate sections to one another or clamping them against one another, wherein some of the plate sections (X direction) have been rotated through 90° with respect to the other plate sections (Y direction).

3. Tube construction according to Claim 2, used in a ship's shell or tank wall, characterised in that a smooth covering skin has been applied to a plate section on at least one side of the tube construction.

4. Tube construction according to one of the preceding claims, characterised in that at least some of the tubes are filled with rock wool or foam.

5. Tube construction according to one of the preceding claims, characterised in that pairs of adjoining plate sections with tubes in the X direction alternate with pairs of adjoining plate sections with tubes in the Y direction.

6. Tube construction according to one of Claims 1 to 4, characterised in that the construction consists of, in succession, a tube extending in the X direction, a tube extending in the Y direction, two tubes extending in the X direction, a tube extending in the Y direction and a tube extending in the X direction.

7. Tube construction according to one of Claims 1 to 4, characterised in that the construction consists of, in succession, two tubes extending in the X direction, two tubes extending in the Y direction and two tubes extending in the X direction.

8. Tube construction according to one of Claims 5 to 7, characterised in that the said construction is used for a heat exchanger.

9. Tube construction according to one of the preceding claims, characterised in that the tubes are made of a plastic composite.

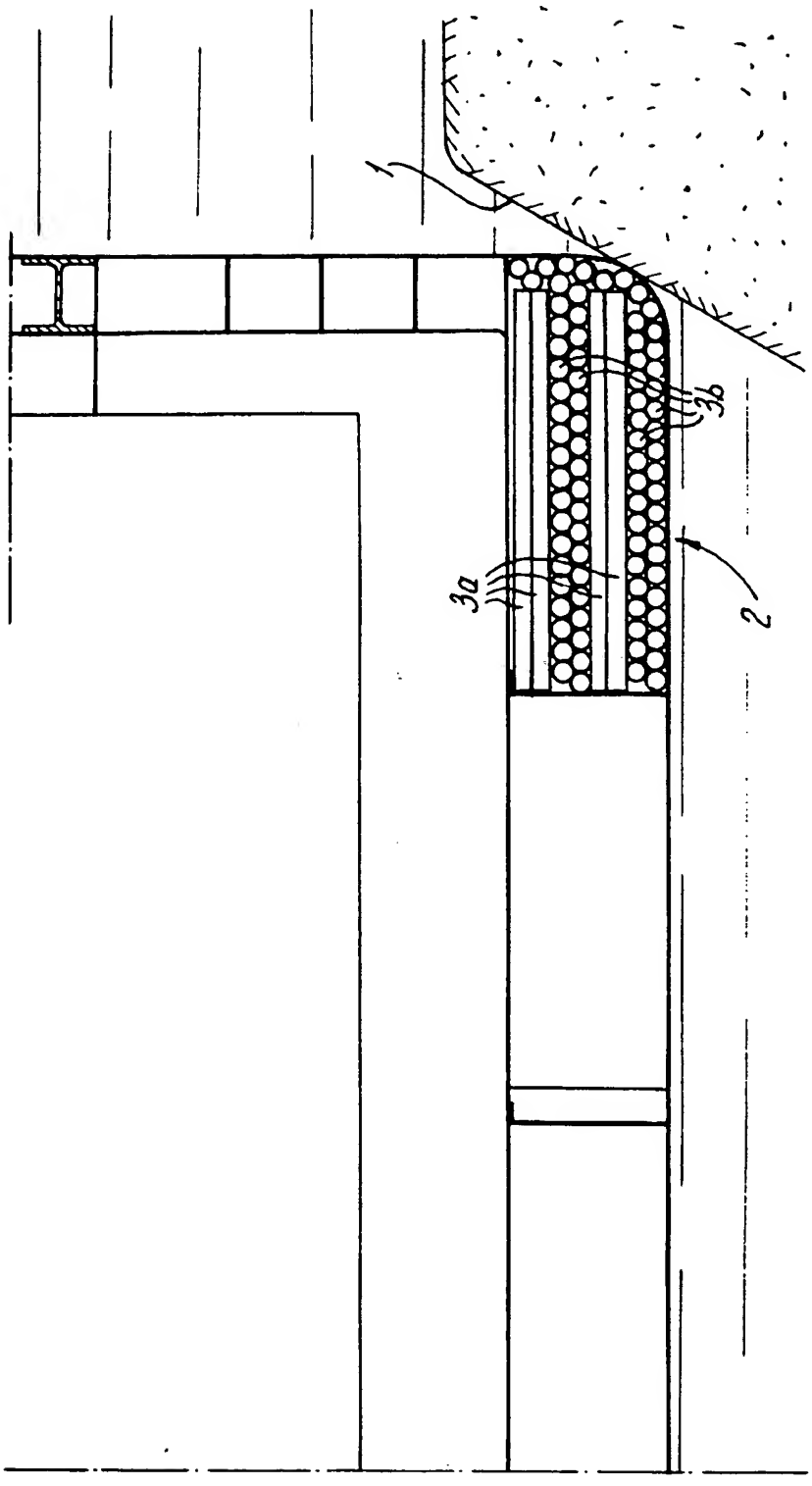


Fig-1

fig-2

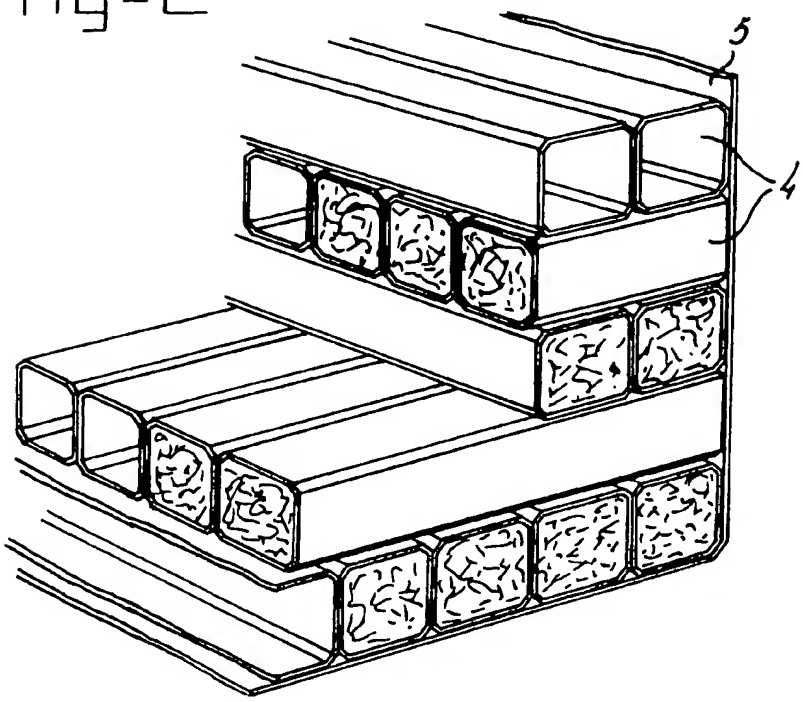


fig-3

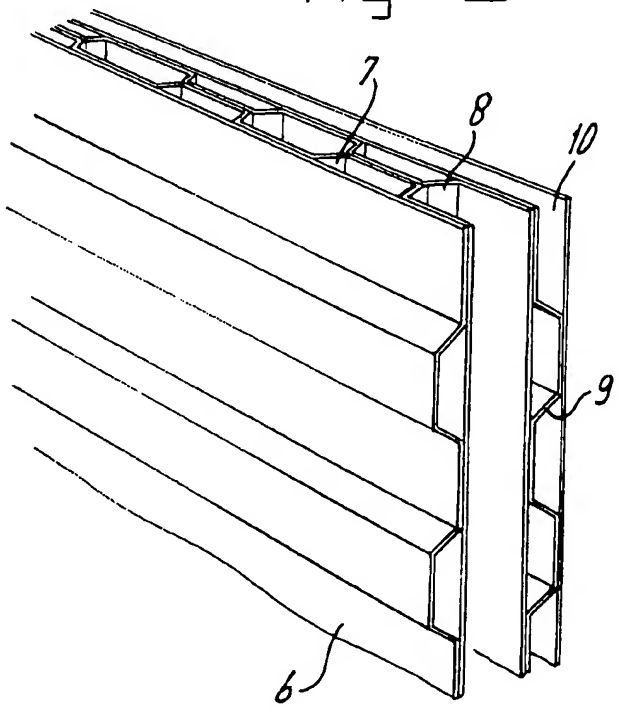


Fig-4

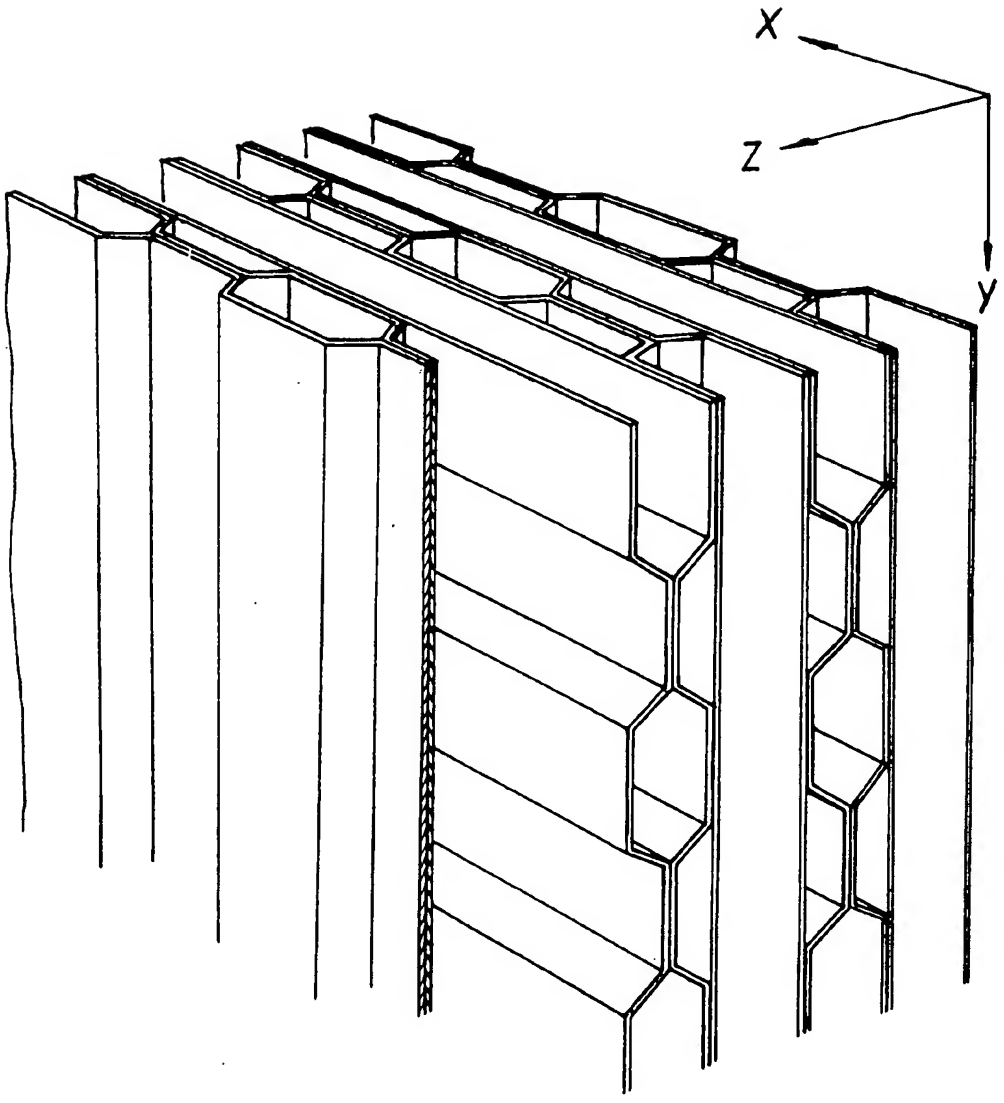


Fig-5

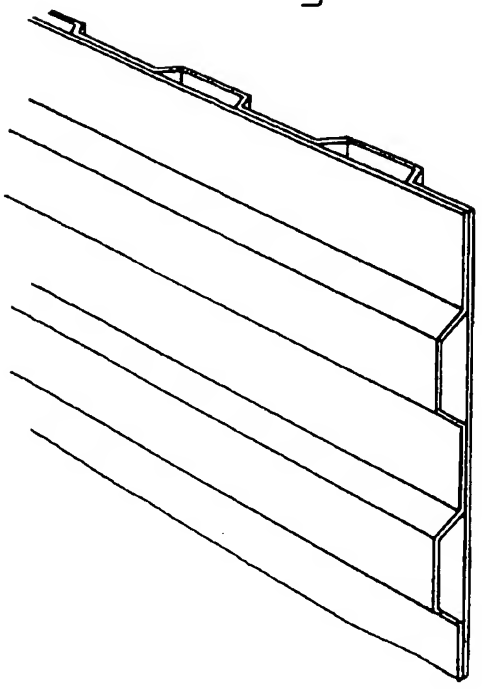
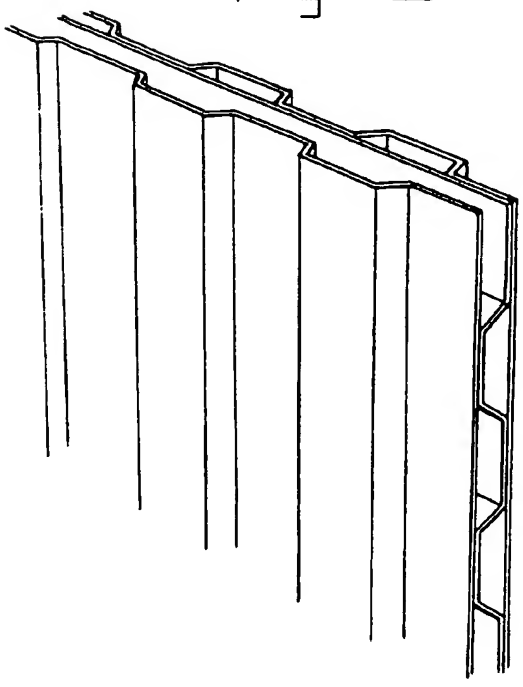


Fig-6



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EUROPEAN SEARCH REPORT

Application Number
EP 97 20 0960

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	FR 2 276 437 A (MERA-ZSM) * the whole document * ---	1-3,5-7 4	B63B43/00 E04C2/34 B63B43/18
Y	US 3 538 878 A (S.ZALMAN) * abstract; claims; figures * ---	4	B63B11/04 B63B3/62 B63B3/20
X	BE 529 567 A (L'ALUMINIUM FRANCAIS) * claims; figures * ---	1-3,5-7	
X	CH 254 025 A (JÖNKÖPINGS OCH VULCANS TÄNDSTICKSFABRIKSAKTIEBOLAG) * page 1, line 32 - line 56; figures * ---	1-7,9	
X	DE 21 19 863 A (W.LANGFELDT) * claims; figures * ---	1-3,5-7,9	
X	GB 432 274 A (J.AUBANEL) * figures * -----	1-3,5-7	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B63B
E04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 August 1997	Stierman, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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